Social diversity and bridging identity

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Abstract

We investigate within a model of cultural transmission how policies or shocks that affect social diversity within a population affect social cohesion and segregation. We develop the concept of 'bridging identity', an individual trait that (i) positively affects utility in culturally diverse social groups but is immaterial in homogeneous groups; (ii) is fostered in those born in culturally diverse social groups but not in those born in homogeneous groups. We show that medium levels of immigration lead to higher bridging identity in the population; and, for a given immigration target, social segregation is decreasing in the time allowed for achieving this target. If the level and pace of immigration are attuned to existing levels of bridging identity, it is possible to sustain, for the long run, social groups that are culturally diverse. This contrasts with Schelling's models of residential segregation that typically lead to increasing segregation over time.

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1 Introduction

A shared social identity is potentially an important element in ensuring cooperation and the coordination of actions among individuals when formal institutions for achieving these ends are weak. In particular, 'group identity' can provide social groups with an evolutionary advantage – by encouraging its members to treat others within the group as 'one's own', thus promoting cooperation, reducing the scope of internal conflict and fostering group solidarity in the face of external threats (Henrich and Henrich 2006; Bowles and Gintis 2011; Eaton, Eswaran and Oxoby 2011).

But the construction of group identity also leads to the creation of in-groups and out-groups and thus, the possibility of conflict as people born and raised with diverse identities are compelled to interact due to resource competition, market forces, etc. This argument is supported by a large body of empirical evidence which shows that ethnic divisions increase the risk of conflict (e.g. Montalvo and Reynal-Querol 2005; Esteban, Mayoral and Ray 2012); and lower public good provision (e.g. Easterly and Levine 1997; Alesina et al. 2003; Banerjee, Iyer and Somanathan 2005). On the other hand, there are also examples of cross-cultural collaboration that improve prosperity and reduce conflict. For example, Jha (2013) argues, in the context of South Asia, that medieval overseas trading ports were characterized by greater cooperation across religious groups because of inter-group complementarities in production and provides evidence that these ports were five times less prone to religious riots than other parts of the subcontinent over several generations.[1]

These contrasting narratives lead to the following question: Under what conditions does increased social diversity within a population – e.g. due to migration, market penetration – raise the potential for conflict as opposed to harmonious social diversity? If 'group identity' plays a key role in shaping conflict and cooperation, a related question that requires consideration is as follows: How does increased social diversity affect identity?

Insights into these questions can potentially be obtained by a growing psychological

[1] Relatedly, Catalonia and Quebec have been presented as examples of successful intercultural dialogue which allows for diverse yet cohesive society even when faced with immigration and economic crises (e.g. Bello 2017; Cantle 2012; Conversi and Jeram 2017).

literature on the adaptation of the children of immigrants to their present environment – given that they typically experience, while growing up, a greater level of social diversity than their parents. The literature highlights that second generation immigrants have lower levels of adaptation than first generation immigrants (e.g. Sam and Berry 2010; Noels and Clement 2015), a phenomenon often referred to as the 'Immigrants Paradox'. Relatedly, the recent medical literature provides evidence that second generation immigrants have a higher risk of psychosis than first generation immigrants (Kirkbride 2017).

To shed light on these questions, in this paper we develop a model of cultural transmission (Cavalli-Sforza and Feldman 1981; Boyd and Richerson 1986; Bisin and Verdier 2001) with three key features:

(i) individuals carry multiple identities – an immutable 'cultural identity' and a 'bridging identity' (discussed at greater length below) that facilitates cooperation as opposed to conflict across different cultural identities;

(ii) identities are transmitted from parent to offspring and via social groups;

(iii) adults choose which social group (e.g. neighbourhood, workplace, club) to join; and this choice determines the individual's access to club groups, individual experience of conflict, and identity of one's offspring.

Group selection brings about its own dynamics and, often, unexpected outcomes, as first pointed out by Schelling (1969, 1971). But we propose to introduce an added dimension to this process by allowing the social groups to play a role in cultural transmission. The concept of a 'bridging identity' is based on a growing literature in psychology that documents the creation of 'dual identities' as a strategy for adaptation to a new, diverse, cultural environment that enhances creativity and problem-solving (see Gocłowska and Crisp 2014 for a review). We formalize this concept as an individual trait that (i) positively affects utility in culturally diverse social groups but is immaterial in culturally homogeneous social groups; (ii) is fostered (probabilistically) in those born in culturally diverse social groups but not in those born in culturally homogeneous social groups. In our formulation, the bridging identity of an individual is negatively related to the 'price' that she/he pays for cultural diversity. Therefore, to the extent that cultural diversity is economically beneficial, a policy

that raises bridging identity within a population is welfare-improving.

We investigate the dynamics of social groups (that are initially in a steady-state) in response to different types of shocks or policies. In particular, we apply the model to investigate how various immigration policies affect cultural diversity within social groups and individual welfare in the long-run. We show that (i) medium levels of immigration are associated with higher bridging identity in the population compared to low or high levels of immigration; (ii) for a given immigration target, the extent of social segregation within the population is decreasing in the time allowed for achieving this target. Therefore, a policy that aims at a moderate level of immigration at a gradual pace will tend to be welfare-improving compared to policy alternatives.

The driver behind these results is the assumption that cultural diversity within social groups fosters bridging identity within the next generation. The latter, in turn, leads to a stronger preference for cultural diversity. However, if immigration from a minority cultural group occurs too rapidly or on too large a scale, this causes individuals to leave culturally diverse social groups before bridging identity can be generated. When social groups are unstable – by which we mean that at least some individuals in the population prefer to join, as adults, different social groups from those in which they were born – this typically leads to segregation by culture and identity across social groups over time. On the other hand, if the level and pace of immigration are attuned to existing levels of bridging identity within the population, it is possible to sustain, for the long run, social groups that are culturally diverse. This is in contrast to Schelling's models of residential segregation (Schelling 1969, 1971) that typically lead to increasing segregation over time.

Our analysis is closely linked to ongoing policy debates on immigration and the social integration of immigrants; particularly in Organization for Economic Cooperation and Development (OECD) countries where inward migration of minority groups have led to growing concerns about social cohesion and national identity. For example, Cantle (2012) argues that while populations are increasingly composed of people from different cultures, faiths and ethnicities as a result of globalization, existing policies have failed to respond to these changes adequately, and a paradigm shift is necessary if governments are to formulate poli-

cies that maintain social cohesion in diverse societies. Similar arguments have been made by the Council of Europe (2008) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).[2]

In this context, our theoretical results resonate with some key policy recommendations to emerge from recent sociological studies. As an example, Kaufmann and Harris (2014) use longitudinal household surveys, focus group discussions, and local election results to study trends in attitudes towards immigrants in the UK; and conclude that 'mass concern over immigration is driven by the rate of change in the non-white British population ... Gradual, diffuse increases in diversity [through housing and refugee resettlement policy] are preferable. Concern dissipates over time as members of the ethnic majority become used to a larger immigrant presence' (p. 10). Our theoretical model yields similar predictions and recommendations when we consider how an influx of immigrants from a minority group affects identity and location choice within a population.

Our notion of 'bridging identity' differs from social capital because it is specific to an individual and not dependent on social connections between individuals. In particular, when individuals move from one social environment to another, they may lose social capital in the process but, according to our conception, this does not affect their bridging identity. The recent literature distinguishes between two types of social capital: 'bonding capital' and 'bridging capital' which are defined, respectively, as 'ties to people who are like you in some important way' and '... unlike you in some important way' (Putnam 2007). According to these definitions, while 'bridging identity' can help foster 'bridging capital', an important distinction between the two concepts is that the former affects wellbeing independently of one's social connections, even when one is among strangers. Our notion of 'bridging identity' is more akin to human capital but differs from the latter in an important way: while human capital investments, as generally conceived, can occur in any social environment, a culturally diverse environment is necessary to generate bridging identity.

The rest of the paper is organized as follows. We discuss the related literature in Section 2. The theoretical model is introduced and developed in Section 3. In Section 4, we use

[2]See, for example, https://en.unesco.org/themes/intercultural-dialogue (last accessed 26/11/2020)

the model to study how immigration, and alternative immigration policies, affects cultural diversity, social cohesion and welfare of the pre-existing population. We compare our theoretical results with historical examples of the effects of immigration. In Section 5, we apply the model to study two other phenomena related to immigration and cultural diversity: the 'Immigrants Paradox' and 'identity shocks'. Conclusions are provided in Section 6.

2 Related Literature

This paper is related to a number of distinct strands in the literature which we highlight and discuss briefly in this section. A large literature – going back to the seminal work by Schelling (1969, 1971) – has looked at the question of residential segregation by race, in particular the type of initial conditions and preferences that generate such patterns or reverse it. Recent work in this literature include Zhang (2011), which confirms Schelling's key insights for a wide class of models, and Dubois and Miller (2017) which introduces individual preferences regarding the minority, separately from individual preferences regarding each social group. Our main contribution to this literature is that we endogenize preferences using the concepts of cultural transmission, imperfect empathy and bridging identity. A subset of this literature has also looked at how changes in social inequality affects social segregation (e.g. Sethi and Somanathan 2004; Bayer, Fang and McMillan 2014). While we do not have a notion of social inequality in our theoretical model, this is a natural extension to the setup we introduce, which we leave to future work.

Our work follows a literature on intra-generational transmission of identity where children are assumed to acquire identity traits from their parents and the social environment (e.g. Bisin and Verdier 2000; 2001; Bisin, Patacchini, Verdier and Zenou 2011; 2016; see Bisin and Verdier 2011 for a review). But, given our interest in issues related to immigration and identity, we propose additional structure to preferences that goes beyond the canonical cultural transmission model. Within the cultural transmission literature, Bisin, Patacchini, Verdier and Zenou (2011) (henceforth BPVZ) comes closest to our work as it investigates how social interactions between distinct cultures affect identity. As in our model, children

inherit their parents' cultural identity in the BPVZ framework and have a secondary identity which may be 'mainstream' or 'oppositional' (which has some parallels with our concept of 'bridging identity').

However there are a number of key differences in their approach and our own. First, within the BPVZ framework, there is no scope for identity to evolve within the mainstream culture (all the dynamics occur within the minority group) while in our model, individuals from both cultures have to evolve (towards a higher level of 'bridging identity') if the society is to achieve higher social integration. Second, the main strategic decision available to individuals in our model – that shapes current utility and the preferences of the next generation – is which social group to join (similar to the literature on residential segregation discussed above), while in the BPVZ framework individuals do not choose social groups but, instead, make investments in the 'intensity' of their own identity.

Carvalho (2013) develops a theory of veiling as a means of self-control against behaviour proscribed by religion. Parents care about the offspring's behaviour and can invest in religious education to influence their likelihood of being religious or secular in adulthood. In an extension to the model, Carvahlo also allows individuals the choice of interacting only within their community (segregate) or engaging outside of the community (integrate), which in turn affects veiling and religious education.

There are a number of parallels between Carvalho's model and our own, e.g. parental choices affect the identity of offspring; and identity affects the relative attractiveness of segregation versus integration. But an important point of departure in our model is that the composition of social groups are endogenously determined and, in turn, affects identity in the next generation. Carvalho (2013) shows that a ban on veiling will increase the individual tendency to segregate. In our model, such a ban (which can be represented by an increase in disutility that individuals experience in culturally mixed groups when they have low bridging identity) will additionally make the population more segregated, resulting in lower bridging identity in the next generation. Thus, even parents with high bridging identity end up with children with lower bridging identity. In short, endogenous social group composition together with the notion of bridging identity highlights how a policy like a ban on veiling

negatively affects not only those with high levels of religiosity but individuals across the identity spectrum.

Finally, our work is related to the literature initiated by Akerlof and Kranton (2000, 2002, 2005) introducing endogenous identity within economic models. While identity is endogenous in our model, our approach differs in the way that identity affects utility. More precisely, in the Akerlof-Kranton models, deviating from the 'ideal' specific to an identity category creates disutility while, in our case, increasing the 'distance' in the social identity between two interacting individuals generates disutility.

3 Theoretical Model

3.1 Setup

Here we describe the setup of our theoretical model. We provide a discussion on our key assumptions and their relation to the existing literature in the next subsection before proceeding to the analysis of the model.

Consider a population consisting of a continuum of individuals of measure 1 indexed by i. Each individual is described by two traits or 'identities'. We call these 'cultural identity' denoted by $q_i \in \{\text{A,B}\}$ and 'bridging identity' denoted by $p_i \in [0,1]$. Individuals choose to join a finite number of 'social groups' (we specify the timing of these decisions below) indexed by $j \in \{1,2,..,m\}$. We denote by Q_j^A and Q_j^B the fraction of individuals in social group j from cultures A and B respectively. The level of utility obtained by individual i from joining social group j is given by

$$U\left(P_{ji}, Q_j\right) \tag{1}$$

where

$$Q_j = \min\left\{Q_j^A, Q_j^B\right\} \tag{2}$$

and

$$P_{ji} = \begin{cases} \boxed{1 - Q_j + Q_j p_i \text{ if } i \text{ belongs to the majority culture in social group } j} \\ \boxed{Q_j + (1 - Q_j)\, p_i \text{ if } i \text{ belongs to the minority culture in social group } j} \end{cases} \tag{3}$$

Thus $Q_j \in [0, 0.5]$ is a measure of cultural diversity in social group j, while P_{ji} is intended to capture the fraction of people within the social group j with whom individual i will 'get along'. We refer to P_{ji} as the individual experience of social cohesion by individual i in social group j. We assume that i will get along with anyone from his or her own culture and a fraction p_i of individuals from the other culture. We assume that the function $U(.)$ is twice continuously differentiable, increasing and concave in each argument, and has a positive cross-derivative (i.e. $\frac{\partial U}{\partial Q}, \frac{\partial U}{\partial P} > 0$, $\frac{\partial^2 U}{\partial Q^2}, \frac{\partial^2 U}{\partial P^2} < 0$ and $\frac{\partial^2 U}{\partial P \partial Q} > 0$).

Each individual i has an offspring o after joining a social group. The transmission of identities from one generation to the next occurs as follows. We assume that $q_o = q_i$, i.e. the offspring inherits the parent's cultural identity. Furthermore, with exogenous probability $\alpha \in (0, 1)$, we have $p_o = p_i$; and, with probability $(1 - \alpha)$, we have $p_o = \tau(Q_j)$ where $\tau(.)$ is a continuously differentiable, monotonic function with $\tau(0) = 0$ and $\tau(0.5) = 1$. Thus, with some probability, the offspring inherits the parent's bridging identity; otherwise, the offspring's bridging identity depends on the level of cultural diversity within the parent's social group. As per the definitions provided by Bisin and Verdier (2005), we refer to cultural transmission from parents as 'direct vertical socialization' and cultural transmission via the social group as 'oblique socialization'.

Then, the level of cultural diversity within a social group that would maximize the utility of an individual i is given by

$$\hat{Q}(p_i) = \arg \max_{P_{ji}, Q_j} U(P_{ji}, Q_j) \text{ subject to } P_{ji} = 1 - Q_j + Q_j p_i \tag{4}$$

The optimization problem is similar to a standard consumer optimization problem where the 'price' of P_{ji} is equal to 1 and the 'price' of Q_j is equal to $(1 - p_i)$; thus, individuals with a higher level of 'bridging identity' pay a lower price for cultural diversity.[3] An individual's actual choice of social group is complicated by two factors not captured in (4), which we discuss below.

[3]Note that the optimisation problem in (4) implicitly assumes that, in i's optimal social group, i will always belong to the majority culture. The assumption is valid given that, for any social group in which i would belong to the minority culture, i experiences a higher level of utility from an alternative social group with the same level of cultural diversity where she belongs to the majority culture.

First, we assume that each individual cares not only about her own utility but also the welfare of the child using 'imperfect empathy', i.e. the parent evaluates the child's outcome using her own preferences (Bisin and Verdier, 2001). To formalize this notion, we assume that each individual i has the following objective function:

$$U\left(P_{ji}, Q_j\right) + \beta \mathbf{E} W\left(p_i, p_o\right) \tag{5}$$

where $W\left(p_i, p_o\right)$ is the parent's expected utility from the child-related outcomes when the parent chooses social group Q_j and $\beta \in (0,1)$ is a discount factor. We define $W\left(p_i, p_o\right)$ in terms of the following Bellman equation:

$$W\left(p_i, p_o\right) = U\left(1 - Q^*\left(p_o\right) + p_i Q^*\left(p_o\right), Q^*\left(p_o\right)\right) + \beta \mathbf{E} W\left(p_i, p_{oo}\right) \tag{6}$$

where $Q^*\left(p_o\right)$ is the offspring's optimal group choice and p_{oo} represents the bridging identity of the offspring's offspring (equal to p_o with probability α and $\tau\left(Q^*\left(p_o\right)\right)$ with probability $1-\alpha$). In line with the notion of imperfect altruism, in (6) the offspring's utility as an adult and the offspring's utility from the next generation are both evaluated using the parent's bridging identity p_i. In Appendix A, we show the existence and uniqueness of the function $W\left(p_i, p_o\right)$ defined in (6) and establish the following properties: $\frac{\partial W(p_i, p_o)}{\partial p_o} \lesseqgtr 0$ for $p_0 \lesseqgtr p_1$ and $\frac{\partial^2 W(p_i, p_o)}{\partial p_i \partial p_o} > 0$; i.e. an individual's expected utility from subsequent generations is increasing in the offspring's level of bridging identity when this is below her own and vice versa; and increases in her own bridging identity makes this expected utility more sensitive to changes in the offspring's bridging identity.

Second, we assume that, when joining a social group, individuals must choose from the set of existing social groups rather than the set described by the condition (3). The initial set of social groups is exogenously given and the set of social groups in subsequent periods is determined endogenously by past choices of other individuals.

The timing of events within each period is as follows.

1. Each adult i in the population decides which social group to join from an existing set $\{1, 2, .., m\}$. These decisions are made simultaneously and without coordination. Individuals make social group choices optimally based on the characteristics of existing

social groups in the current period but do not anticipate any future changes in their composition.

2. Each adult i produces an offspring o. Offspring inherit their parents' cultural identity and their bridging identity is determined by that of their parents and the characteristics of their social group.

3. Offspring become adults and 'replace' their parents in the population. The offspring make their own social group decision as described in (1) above and the process continues.

Note that, as described in stage (1) above, individual decisions about social group choice are myopic, and not best responses to the choices being made by agents in the same period. Therefore, individual decisions do not constitute a Nash equilibrium in any given period. We provide a justification for this assumption in the next section.

3.2 Discussion on Key Assumptions

In the setup above, children inherit their parents' cultural identity, while their bridging identity is determined by the cultural composition of the social group in which they are raised. We assume, implicitly, that the boundaries of cultural identity are exogenously given and that they are hereditary. While this may be a strong assumption, we believe that it is a reasonable approximation when looking at transitions from one generation to the next as any changes in the boundaries of cultural identity are likely to happen very gradually.

We also assume, implicitly, that identity is established in young life. In making this assumption, we are following the recent literature on the transmission of identity (see, for example, Bisin et al. 2011) and a literature on the potential effects of education on cognitive and noncognitive skills (Kautz, Heckman and Diris 2014) which shows that these skills can be shaped more easily in childhood and early adult life due to higher plasticity of the brain. Relatedly, Bauer et al. (2014) find that the experience of external conflict is more influential in shaping behaviour towards the in-group for children than for adults.

We interpret the link between the cultural diversity of a social group and the bridging identity of children raised within it as follows. Children observe the social interactions across different cultures in their surroundings and witnessing these interactions can potentially shape their level of bridging identity. In a socially homogeneous group, children would observe no social interactions across different cultures. Therefore, these children risk acquiring no bridging identity at all, which is why we assume that $\tau(0) = 0$. While it would be reasonable to assume that the bridging identity of children is affected not only by cultural diversity within the social group but also the level of bridging identity of the adult group members, we abstract away from this possibility for reasons of tractability. Nevertheless, it will become apparent in the next section that, in equilibrium, there is a high degree of correlation between the level of cultural diversity and the bridging identity of group members across social groups, and so the former can serve as a rough proxy for the latter.

The assumption of 'imperfect empathy' as represented by the objective function in (5), is adopted from Bisin and Verdier (2000, 2001), and Bisin et al. (2011). It captures the notion that parents care about their children's utility but are incapable of fully putting themselves in their place; therefore they evaluate their children's utility through their own identity or cultural lenses. An alternative expression of the same idea is that parents are characterized by some degree of 'cultural intolerance', a utility loss arising from their children being different from them. In order to decrease the possibility of identity loss, parents will change their behaviour whenever it can affect the identity transmission channels.

While existing models in the cultural transmission literature allow parents to invest directly in the identity of their children (e.g. Bisin and Verdier, 2001; Bisin et al. 2011), we abstract away from these investments and focus specifically on how parents can influence the socialization process for their children by their choice of social group. The choice in question may relate to the neigbourhood in which the children are raised, the school which they attend, the social ties which provide them with alternative role models.

We assume that cultural diversity within a social group positively affects the utility of group members as a concise way to capture the idea that, *ceteris paribus*, a group of individuals with a more diverse set of skills – which may be due to cultural diversity –

will be more productive in the production of club goods. In recent work, Desmet, Gomes and Ortuño-Ortin (2016) find that while linguistic fractionalization within a country lowers public good provision, mixing across linguistic groups at the local level mitigates this negative impact, which provides some empirical support for this assumption.

In specifying the utility function (1), we implicitly abstract away from scale effects. It is plausible that if a social group is very small, it may not be effective in producing the club goods, while very large social groups may cause 'congestion' that negatively affects the welfare of its members. Introducing such scale effects would discourage movement into social groups that are 'too large', and cause out-migration from social groups that are 'too small'. However, our main results will continue to hold in the presence of these additional effects if there are alternative social groups of 'medium size' that are otherwise similar – in terms of cultural composition and bridging identity – to the ones that are 'too large' or 'too small' .

Our assumption that, in each period, individuals choose their social groups simultaneously and without coordination requires some discussion and justification. This assumption implies, in the first instance, that the configuration of social groups at any point in time may be sub-optimal in the sense that there is a rearrangement possible which would make everyone better off. We argue that the extent of coordination that such rearrangements would involve is sufficiently costly to render it socially impractical, for example when the social groups are residential neighbourhoods. For example, when individuals make neighbourhood choices, they are likely to take into account the existing composition of different neighbourhoods but they do not necessarily anticipate what choices their peers – particularly those raised in other communities – will make. Even if coordination is feasible on a small scale, this would not qualitatively change our theoretical results if the scale of coordination is small compared to the size of social groups. Schelling (1969, 1971) and the subsequent literature on neighbourhood choice, discussed in Section 2, also assume absence of coordination.

3.3 Analysis

We address the question posed in the introduction – about the effects of an exogenous increase in cultural diversity – with reference to an initial population involving a 'stable'

set of social groups, which we define formally and characterize in Section 3.3.1. In the case of social groups that are not stable, the population may have complicated dynamics even in the absence of exogenous shocks. We partially characterize these social group dynamics in Section 3.3.2. We use these results in Section 4 to investigate the effects of alternative immigration policies on social segregation and welfare.

We begin by establishing a number of results regarding an individual's preference ordering between different social groups, which will help with the subsequent characterization of stable groups and analysis of dynamics. First, consider an individual who has the choice of joining two social groups, with different levels of cultural diversity, both dominated by her culture. As discussed in the preceding section, an individual with higher bridging identity faces a lower 'price' of cultural diversity. Therefore, intuition suggests that if the individual has a sufficiently high level of bridging identity, she would prefer the more culturally diverse social group and vice versa. Formally, we have the following result (the proofs for all results in this section are provided in Appendix B).

Lemma 1 *Suppose social groups j and j' have the same majority culture and social group j' has higher cultural diversity. Suppose that individual i belongs to the culture that forms the majority in these social groups. (i) If i prefers social group j to j', then any other individual i' from the same culture and a lower level of bridging identity also prefers social group j to j'. (ii) If i prefers social group j' to j, then any other individual i' from the same culture and a higher level of bridging identity also prefers social group j' to j.*

Next, we consider whether and under what conditions an individual would prefer a social group in which her culture constitutes a minority to another where her culture constitutes the majority. In the first instance, consider two social groups with the same level of bridging identity but with different majority groups. Then, it is evident that an individual with bridging identity below the maximum will strictly prefer the social group where her culture constitutes the majority (where she experiences a higher level of social cohesion and the same level of cultural diversity). However, if the two social groups have different levels of cultural diversity, then she may prefer the one in which her culture is in the minority either because

it has a higher level of cultural diversity or because it enables her to transmit a *lower* level of bridging identity to her offspring (which she prefers to do because of imperfect altruism). Formally, we have the following results.

Lemma 2 *Suppose social groups j and $\hat{\jmath}$ have different majority cultures and social group $\hat{\jmath}$ has higher cultural diversity. Suppose that individual i belongs to the culture that forms the majority in social group j. (i) If i prefers social group $\hat{\jmath}$ to j, then an individual i' from the same culture and higher bridging identity also prefers social group $\hat{\jmath}$ to j. (ii) If i prefers social group j to $\hat{\jmath}$, then an individual i' from the same culture and lower bridging identity (weakly) prefers social group j to $\hat{\jmath}$.*

Lemma 3 *Consider two social groups j and j' and social group j' has higher cultural diversity. Suppose that individual $\hat{\imath}$ belongs to the culture that forms the minority in social group j. If $\hat{\imath}$ prefers social group j to j' then $\mathbf{E}_{j'}W(p_{\hat{\imath}}, p_o) - \mathbf{E}_j W(p_{\hat{\imath}}, p_o) < 0$. Conversely, if $\mathbf{E}_{j'}W(p_{\hat{\imath}}, p_o) - \mathbf{E}_j W(p_{\hat{\imath}}, p_o) > 0$, then $\hat{\imath}$ prefers social group j' to j; and any individual i from the same culture and higher bridging identity than i also prefers social group j' to j.*

3.3.1 Stable Groups

Definition 1 *A set of social groups $\mathcal{J}$ is stable if no one member of one social group can improve utility by joining another.*

According to the definition above, given a stable set of social groups, each individual should prefer her own social group to any other in the set. An individual may, of course, belong to either the majority culture or minority culture in one's social group. A stable set may consist of (i) a completely homogeneous population, (ii) a population consisting of two cultural groups but homogeneous social groups, or (iii) a population consisting of two cultural groups and one or more culturally mixed social groups.

Using the lemmas above on social group preferences, we can provide a characterization of 'stable' social groups. Let us first consider the individuals who belong to the majority culture in their social group. Using Lemma 1, we can obtain, for each social group $j \in \mathcal{J}$, an interval $\left[\underline{p}_j, \overline{p}_j\right]$ such that each individual i belonging to the majority culture in j with $p_i \in \left[\underline{p}_j, \overline{p}_j\right]$

prefers social group j to any other social group with the same majority culture. Lemma 1 also implies that if two individuals differ in terms of their preferred social group, then the one who prefers a social group with a higher level of cultural diversity must have a higher level of bridging identity. Based on this reasoning, we obtain the following proposition.

Proposition 1 *Consider a stable set of social groups $\mathcal{J}$. Consider the set of individuals $\mathcal{I}_k$ from culture k who belong to social groups where their culture constitutes the majority. For each social group j dominated by culture k, there exists an interval $\left[\underline{p}_j, \overline{p}_j\right]$ such that each individual $i \in \mathcal{I}_k$ with $p_i \in \left[\underline{p}_j, \overline{p}_j\right]$ belongs to social group j, and social groups with higher levels of cultural diversity are matched with intervals of higher levels of bridging identity.*

We consider, next, the individuals who belong to the minority culture in their social group. Suppose that social groups j and j' are such that $Q_j^A = Q_{j'}^B > 0.5$. Thus, the two social groups have the same level of cultural diversity but different majority groups. It follows that for person i belonging to culture A, we have $U\left(P_{ji}, Q_j\right) > U\left(P_{j'i}, Q_{j'}\right)$. Thus, i would always be less inclined to join social group j where his culture is in the minority compared to another with a similar level of cultural diversity in which his culture is in the majority. It must also be that among the social groups in $\mathcal{J}$ where i's culture is in the majority, either (i) cultural diversity is lower than that in j or (ii) that the expected utility associated with the bridging identity of i's offspring is lower than in the case where i joins social group j. The reason is that if neither of these conditions hold true, then i would be better off joining such a social group as compared to joining social group j. Formally, we can summarize this result as follows.

Proposition 2 *Given a set of stable social groups, if an individual i has opted for social group j where his culture constitutes the minority, then either j has the highest level of cultural diversity in $\mathcal{J}$ or $\mathbf{E}_{j'} W\left(p_{\hat{\imath}}, p_o\right) - \mathbf{E}_j W\left(p_{\hat{\imath}}, p_o\right) \leq 0$ for all $j' \in \mathcal{J}$ with higher cultural diversity.*

Propositions 1 and 2 together provide a characterization of stable social groups. Proposition 1 describes the distribution of individuals who are in social groups where their culture

constitutes the majority, while Proposition 2 provides necessary conditions for an individual to be in a social group where her culture constitutes a minority.

3.3.2 Group Dynamics

Next, we consider how social groups evolve over time in terms of social group composition and bridging identity. We can show that if a parent prefers a social group to any other in the population, then so does an offspring born in that social group, regardless of whether she experiences direct vertical socialization or oblique socialization. Therefore, if a set of social groups is stable at a certain point in time (implying that each adult prefers her own social group to any other) then there is no movement between the social groups in subsequent periods, and they remain stable thereafter (assuming there are no external shocks). Nevertheless, the bridging identity of individuals evolves in a stochastic manner: with some probability, they acquire the bridging identity of their parents; otherwise, their bridging identity is determined by the cultural composition of the social groups in which they are born. As the cultural composition of social groups does not change over time, in the long-run, the offspring have the same bridging identity as their parents which, in turn, is completely determined by the cultural composition of the social groups in which they are born. We formalize these results as follows.

Definition 2 *A social group j is self-replicating if offspring born within the social group have the same preferences as their parents.*

Proposition 3 *If a set of social groups is stable, then so is the set of social groups formed by subsequent generations, with convergence towards a set of self-replicating social groups in which all individuals have the same level of bridging identity.*

An implication of Proposition 3 is that policies and shocks that raise cultural diversity of social groups (for example, by introducing into the population individuals from a cultural minority) *without* making the groups unstable will translate into higher bridging identity and, potentially, higher welfare in the long-run.[4]

[4]For those who belong to the minority cultural group, the impact on welfare is always positive. For those who belong to the majority cultural group, the impact on welfare depends on whether the increase in cultural

Next, we consider how bridging identity and cultural diversity evolves when social groups are *not* stable. Lemmas 1-2 together imply that, with some exceptions, individuals with higher bridging identity will opt for social groups with higher cultural diversity. Their offspring will tend to have high levels of bridging identity relative to those born in social groups with low cultural diversity. This process will segregate individuals with high levels of bridging identity from those with low levels of bridging identity and it will be repeated every period while the social groups remain unstable. Formally, we can state the following result.

Proposition 4 *If a set of social groups is not stable, then there is segregation by bridging identity in each period, in the sense that for any two individuals from the same culture who join different social groups (i) if their culture is in the majority in at least one of these social groups, then the individual with the higher level of bridging identity joins the social group with higher cultural diversity; (ii) if their culture is in the minority in both social groups, the same result is obtained if the expected utility associated with the offspring's bridging identity is higher in the social group with higher cultural diversity for at least one of the individuals*

The implication of Proposition 4 is that policies or shocks that cause social groups to become 'unstable' are likely to result in lower bridging identity and lower welfare for at least a subset of the population. In particular, individuals with high levels of bridging identity will leave social groups that are less culturally diverse and individuals with low levels of bridging identity will join social groups that are already dominated by their own culture. This may cause some social groups to become *less* culturally diverse than they would have been in the absence of the policy or shock. Consequently, these social groups will produce lower bridging identity in the next period. This will negatively impact upon the welfare of the next generation born within these social groups.

diversity is sufficient to offset the potential decline in social cohesion.

4 Influx of Immigrants

Using the theoretical results above, we can construct specific scenarios – in terms of social group composition and bridging identity – and investigate the social dynamics. In this section, we consider how an influx of immigrants from a minority culture – and different policy alternatives regarding immigration – affects bridging identity and long-term welfare within a population. We also compare our theoretical results with historical examples of the effects of immigration.

For our analysis, we work with a specific case where the population is composed of three social groups: (i) a social group in which $Q_j^A = 1$, $Q_j = 0$, labelled j_a; (ii) a social group in which $Q_j^B = 1$, $Q_j = 0$, labelled j_b; (iii) a social group in which $Q_j^A = Q_0^A \in (0.5, 1)$, labelled j. Thus, the j_a and j_b social groups include only individuals from cultures A and B respectively, while the j social group is mixed, but individuals from culture A are in the majority. The existence of the social group j_b is not essential for our reasoning but it serves to illustrate that the theoretical results are robust to the presence of communities composed exclusively of the minority cultural group. The social groups j_a and j are typical of populations where one cultural group is, and has historically been, in the majority and a second cultural group is in the minority. We assume that, initially, the set of cultural groups is stable so as to distinguish the social dynamics generated by the influx of immigrants from any existing dynamics within the pre-immigrant population.

We address two policy-related questions: (a) How does the magnitude of the immigrant influx affect bridging identity and social welfare within the existing population? (b) Does the time over which the influx occurs affect bridging identity and social welfare within the existing population? The following two propositions address these questions (the proofs are provided in Appendix C).

Proposition 5 *Consider a population consisting of three social groups, where two are culturally homogeneous consisting exclusively of culture A and culture B individuals respectively and the third social group is mixed, with culture A individuals in the majority. Suppose the set of social groups is initially stable. The impact of immigration from cultural group B*

on bridging identity within a population is non-monotonic: the long-term average bridging identity in the existing population is higher for medium levels of immigration compared to low and high levels of immigration.

Proposition 6 *Consider a population consisting of three social groups, where two are culturally homogeneous consisting exclusively of culture A and culture B individuals respectively and the third social group is mixed, with culture A individuals in the majority. Suppose the set of social groups is initially stable. For a given immigration target from the cultural group B, the extent of exit by the pre-immigrant population from the mixed social group is decreasing in the length of time allowed for achieving the target.*

The intuition behind these theoretical results is as follows. The new culture B immigrants will divide themselves between the j_b and j social groups. Specifically, using Lemma 2, those with relatively high levels of bridging identity will join the social group j while those with low levels of bridging identity will join the social group j_b. None will join the social group j_a because, as per the reasoning provided in Section 3.3, culture B individuals strictly prefer j_b to the j_a. As culture B is, initially, in the minority in the j social groups, the newcomers will increase culture diversity (as long as their numbers are not too large). In the next period, the culture A individuals with low bridging identity will exit the mixed social group j and join the culturally homogeneous social group j_a. In the long run, the descendents of the culture A individuals who exit will have zero bridging identity but the descendents of those who remain in the mixed social groups will have higher bridging identity than they would have in the absence of immigration. If the initial influx is small, then the latter group dominates the first and there is an increase in average bridging identity in the population. Increasing the size of the influx also increases cultural diversity, and thus bridging identity, in the mixed social group. However, for a sufficiently large influx, enough culture A individuals will leave the mixed social groups such that the long-term bridging identity in the population declines. Thus, we obtain the result described in Proposition 5.

As an alternative to the immigration policy that introduces new culture B individuals into the population in a single period (as discussed above), the flow can be spread over two

or more periods without changing the total size of the influx. As per the reasoning above, the first wave of immigrants will increase cultural diversity in the mixed social groups but if the initial influx is small it would not trigger significant levels of exit from the majority cultural group. The next cohort born in the mixed social groups are raised in an environment of higher cultural diversity and thus have higher bridging identity. Consequently, the next wave of immigrants do not trigger as much exit as if they had arrived in the first period. Thus, spreading the influx of immigrants over multiple periods can lead, in the long-run, to a greater fraction of the pre-immigrant population remaining within the mixed social groups. Thus, we obtain the result described in Proposition 6.

Welfare Effects: Next, we consider how the different immigration policies discussed above impact upon social welfare. These policies affect the welfare of the pre-immigrant population, and their descendants, in two ways. First, immigration affects the proportion of the pre-immigrant population that lives in culturally diverse social groups. These individuals enjoy high levels of cultural diversity which, by assumption, positively affects utility. Second, immigration affects the bridging identity of those born and raised in culturally diverse social groups. Specifically, they have higher bridging identity as adults which, in turn, lowers the 'price' they pay for cultural diversity. Proposition 5 implies that moderate levels of immigration lead to higher levels of bridging identity in the population than low or high levels of immigration. Proposition 6 implies that the fraction of the pre-immigrant population that is retained in culturally diverse social groups is higher when the time allowed for achieving a specific immigration target is increased.

Historical Example: Kaufmann and Harris (2014) use longitudinal household surveys and local election results to study trends in cross-cultural interactions, and attitudes towards minorities and immigrants, in the UK. They find that while minorities are leaving their areas of concentration in favour of culturally mixed communities, the British white population are avoiding or leaving mixed communities for relatively white areas. Strikingly, 'white conservatives and liberals, racists and cosmopolitans all move to relatively white areas at similar rates' but they also find that, controlling for other factors, the British white with a high share of minorities in their neighbourhood have more positive views on immigration.

They argue that this last piece of evidence supports the 'contact hypothesis' (see Pettigrew and Tropp (2006, 2008) for a review of this literature) that 'when white English people have the chance to interact positively with minorities and immigrants in their locale, they form a better opinion of them and feel less threatened'. Moreover, the authors argue that as

> 'young people ... grow up in a more diverse environment and view ... as the 'new normal', a state of affairs in which minorities are a legitimate part of English society, and hence the civic nation ... minorities and whites come to share an English and British national identity, though the two remain ethnically distinct'. Kaufmann and Harris 2014, p. 14.

Kaufmann and Harris' notion that an individual's degree of exposure to social diversity (in the local environment, especially in youth) shapes her or his preferences regarding other cultures, is one of the driving mechanisms of our model. Therefore, it is useful to examine how the model's predictions regarding the impact of an influx of immigrants from minority groups on cultural diversity and cross-cultural attitudes compare with the patterns uncovered by Kaufmann and Harris for the UK.

Propositions 5 and 6 imply that an influx of immigrants from a minority group can either help or harm social interactions across different cultures. When the influx of migrants is large, or occurs within a short period, individuals from the majority culture move away from the culturally mixed social groups towards groups where their own culture dominates. These results are similar to the recent trends in the UK documented by Kaufmann and Harris (2014) – the British white leaving mixed communities for relatively white areas, even as minority groups leave their areas of concentration for more mixed communities. Propositions 5 and 6 also imply that moderate levels of immigration over an extended period would lead to a higher fraction of the pre-immigrant population living within culturally mixed social groups and better social interactions across different cultures. This reasoning mirrors the conclusion reached by Kaufmann and Harris (2014) regarding immigration to the UK, that 'mass concern over immigration is driven by the rate of change in the non-white British population ... Gradual, diffuse increases in diversity are preferable. Concern dissipates over

time as members of the ethnic majority become used to a larger immigrant presence.' (p.10)

5 Further Applications

In this section, we consider whether and, if so, how the theoretical model can explain other elements of social interactions across different cultures, making use of historical examples. First we look at the impact of migration on the wellbeing of the immigrants themselves, specifically the phenomenon known as the 'Immigrants Paradox'. Next, we discuss the impact of 'identity shocks' on cultural diversity and social cohesion, as documented in the empirical literature. Until recently, data of individual attitudes towards social diversity, with consistent measures over time and across populations, has been scarce. But there have been recent attempts to improve the quality of data. The European Social Survey, for example, now provides data on attitudes over a reasonable time span, enabling us to detect changes in social attitudes across generations.

5.1 Immigrant's Paradox

There is growing empirical evidence on the wellbeing and attitudes of second generation immigrants compared to that of their parents. A surprising finding in this literature is that indicators of social integration are often – although not always – lower for second generation immigrants relative to their parents, a phenomenon commonly referred to as the 'Immigrants Paradox'. For example, recent studies in psychology highlight that second generation immigrants have lower levels of adaptation than first generation immigrants (e.g. Sam and Berry 2010; Noels and Clement 2015). The Indicators of Immigrant Integration (2015) shows that, in the European Union, one-fifth of young people born in the host country to foreign-born parents report belonging to a group that feels discriminated against on the grounds of ethnicity or nationality. In fact, they are more likely to report being discriminated against than young immigrants. For non-EU OECD countries, the reverse is true. In our next example we consider whether, and under what conditions, the theoretical model generates the 'Immigrants Paradox'. The following example allows us to discuss this in the context of

our model.

Example 1 Consider a population consisting of three social groups as described in Section 4. Let us suppose there is an influx of individuals from culture B into the population, with varying levels of bridging identity, who decide which of the existing social groups to join. We refer to them as first generation immigrants. There will be a threshold level of bridging identity such that newcomers whose identity levels are above this threshold will opt for group j.

Those born in social group in j in the next period will experience either oblique socialization (i.e. bridging identity determined by the cultural diversity of the parental social group) or direct vertical socialization from their parents. Consider immigrants with bridging identity above $\tau(Q_j)$. A fraction $(1-\alpha)$ of their children will experience oblique socialization. These children will obtain a lower level of bridging identity and, consequently, experience a lower level of utility, than their parents if they remain within the same social group. This generates a version of the Immigrant's Paradox in our model.

Under what circumstances is the Immigrant's Paradox more likely to arise? Note that the children of immigrants who experience oblique socialization in fact end up with a higher level of bridging identity than their parents who are *below* $\tau(Q_j)$. Therefore, the Immigrant's Paradox is generated by those above the threshold. *Ceteris paribus*, the lower the initial level of cultural diversity in the social group j, the higher the proportion of first generation immigrants who are above the threshold $\tau(Q_j)$ and, thus, the higher the proportion of second generation immigrants who fare worse than their parents.

5.2 Identity Shocks

Next, we consider how 'identity shocks' affect social interactions across different cultures. By an 'identity shock', we mean an exogenous event that affects an individual's own sense of identity, their perceptions about the identity of others, or beliefs about how they themselves

are being perceived. One example of such an event are the terror attacks in the United States on 11 September 2001, which potentially affected perceptions of Muslim immigrants as well their own beliefs about how they were being perceived. Gould and Klor (2016) document a rise in hate crimes against Muslims in the United States following the 9/11 attacks, and use variation in the increase across states to show that the backlash 'made the Muslim community in America more cohesive and traditional.'

Another example of an identity shock is the 'Swiss minaret initiative' of 2009 – a national ballot in which Swiss citizens voted on whether the construction of minarets should be prohibited. A clear majority voted in favour of the prohibition, against the prediction of leading pollsters. Slotwinski and Slutzer (2015) argue that the outcome of the vote provided immigrants with new information about how Swiss citizens perceived foreigners, and show that it decreased movement of immigrants into municipalities that opposed minarets most strongly relative to prior predictions. Relatedly, Rudert, Janke and Greifeneder (2017) investigated immigrant's responses to another anti-immigration vote in Switzerland, the so-called popular initiative against mass immigration in 2014. They report the vote negatively affected attitudes of high-skilled immigrants towards Switzerland as well as their reported life satisfaction.[5]

In this final example, we represent a negative identity shock as a temporary decline in bridging identity, and consider how it affects movements across social groups, and cross-cultural interactions within social groups, over time.

Example 2 *A Negative Shock to Bridging Identity:* Consider, again, a population consisting of three social groups as described in Section 4.

Let us suppose that there is a temporary negative shock to bridging identity. Formally, suppose that the process of oblique socialization is given by $p_i = \tau(\sigma Q_j)$ where σ is a random variable. In normal times, $\sigma = 1$ and, therefore, cultural transmission follows the process described above. However, during a period of conflict, σ falls below one

[5] Kaufman and Harris (2014) present some interesting historical examples of positive identity shocks such as the impact that the ecumenical movement in Christian churches may have had on the integration of Protestants and Catholics in Northern Ireland.

such that offspring who experience oblique socialization end up with a lower level of bridging identity than that which they would acquire from their social group during normal times. To be concrete, let us suppose that the negative shock lasts for one period exactly.

Note that this shock does not affect cultural transmission in social groups j_a and j_b above. But it lowers bridging identity among offspring who experience oblique socialization in the social group j. Then, using Lemma 1 we can show that for σ sufficiently small, these offspring will prefer social groups j_a or j_b (according to their cultural identity) to the social groups j. If the same proportion of offspring of each culture choose to exit, then the cultural diversity in social group j remains unchanged. Then we can show that, in the next period, the set of social groups is stable once again. Using Proposition 3, it remains stable in subsequent periods.

However, as individuals from culture B are in the minority in social group in j, they experience a lower level of social cohesion than those from culture A for the same level of bridging identity. Therefore, it is likely that offspring from the minority group exit at a greater rate than those from the majority group. In the next period, cultural diversity within these social groups declines. As a result, offspring would acquire a lower level of bridging identity even in the absence of a shock. Consequently, the set of social groups may no longer be stable. If so, culture B individuals born in social group j with low levels of bridging identity will opt for the social group j_b. This will further reduce cultural diversity in the mixed social groups and so the process of outward movement from these social groups will continue. Thus, a temporary shock to bridging identity triggers a dynamic process which lowers cultural diversity over time.

The theoretical example illustrates, first, how a temporary shock to bridging identity can have long-term effects on cross-cultural interactions. Second, it shows that those adversely affected are the ones with the highest levels of bridging identity within the society, with little change experienced by individuals who have low levels of bridging identity and already live in segregated social groups.

We consider how these theoretical results compare with empirical findings on identity shocks. Gould and Klor (2016) find that, following the 9/11 attacks in the United States, Muslim immigrants living in states with the sharpest increase in hate crimes exhibit lower English proficiency; which is suggestive of reduced interactions with the (majority) English-speaking population. Furthermore, this effect is concentrated among immigrants who arrived in the United States before the age of 20, with no statistically significant effects for those who arrived as adults. To the extent that immigrants raised and schooled in the United States have more exposure to the majority culture, this is consistent with the theoretical result that the effects of the identity shock are concentrated among those with high levels of bridging identity.

The theoretical model also reproduces the basic finding by Slotwinski and Slutzer (2015) that the Swiss vote on minarets reduced movement of foreign immigrants into municipalities that voted most strongly in support of prohibition relative to expectations. Additionally, they find that high-skilled foreigners were the most sensitive to the vote in terms of their location choice decisions. Rudert et al. (2017) also find evidence of a strong effect of the vote on high-skilled migrants' self-reported life satisfaction and attitudes towards Switzerland. If high-skilled foreign migrants also have high levels of bridging identity, these findings are consistent with the predictions of the model.

The negative effects of the vote reported by Rudert et al (2017) were mitigated for immigrants who had a higher proportion of Swiss friends. Relatedly, Slotwinski and Slutzer (2015) observe that Swiss-born immigrants were less sensitive to the vote relative to foreign-born immigrants. We argue that these groups of people exhibited a weaker response to the vote as they would have alternative sources of information about the bridging identity of Swiss residents in different communities – therefore, the outcome of the vote was less akin to an identity shock for them.

6 Conclusion

Changes to population composition due to migration policy or economic shocks may pitch identifiable cultural groups against each other and impact upon the wellbeing of individuals. For the young, these changes may affect their evaluation of social interactions in their community at a time when their individual identities are being shaped. This process can have consequences not just for the individual but also for society at large (Singh and vom Hau 2016). Ethnic diversity has often been linked to poor public good provision and conflict. However, it is often segregation rather than diversity which may be behind those problems (Corvalan and Vargas 2015). It is therefore important to understand how external shocks – and individual responses to them – may lead societies to become more or less segregated.

In this paper, we explored these issues in a location choice model à la Schelling where there is cultural transmission across generations. To model individual preferences regarding social diversity and the evolution of these preferences, we draw on evidence from psychological studies and introduce the concept of 'bridging identity', an individual trait that (i) positively affects utility in culturally diverse social groups but is immaterial in culturally homogeneous social groups; (ii) is fostered (probabilistically) in those born in culturally diverse social groups but not in those born in culturally homogeneous social groups.

We investigate the dynamics of social groups over time – particularly social group composition and social cohesion within groups – in response to different types of policies and shocks. We show that the relationship between the scale of immigration and the long-term bridging identity within a population is non-monotonic, with medium levels of immigration associated with higher bridging identity in the population compared to low or high levels of immigration. For a given immigration target, the extent of social segregation within the population is increasing in the time allowed for achieving this target. As the bridging identity of an individual is negatively related to the 'price' that he/she pays for cultural diversity, a policy that aims at a moderate level of immigration at a gradual pace will tend to be welfare-improving compared to policy alternatives.

We also show that a temporary negative shock to bridging identity can trigger a dynamic

process of segregation in the form of exit from culturally diverse social groups. We argue that these theoretical results are consistent with empirical findings on recent episodes of migration and 'identity shocks' that have been shown to affect cross-cultural interactions within European countries.

Our model considers the implications of 'bridging identity' specifically within a location choice model, but the concept, we argue, is also pertinent for – and can provide insights regarding – other economic decisions that have implications for cross-cultural interactions.

Supplementary material

Supplementary material is available on the OUP website. The supplementary material comprises the Online Appendix which contains Appendices A, B and C.

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Appendices

Appendix A: Expected Utility derived from the Offspring's Choice of Social Group

In this section, we derive the properties of the function $W(p_i, p_o)$ defined in Section 3.1. For this exercise, we require a technical condition on $\tau(.)$ as follows.

Assumption 1 $\|\tau''(.)\|_{Q\in[0,0.5]} \leq \frac{B_{22}(1-\beta\alpha)}{B_1\beta(1-\alpha)}$ *where* $B_{22} = \inf_{P\in[0,1],Q\in[0,0.5]} |U_{22}(P,Q)|$ *and* $B_1 = \|U_1(P,Q)\|_{P\in[0,1],Q\in[0,0.5]}$.

From the definition of $W(p_i, p_o)$ in (6), we obtain

$$W(p_{-1},p_0) = U(1-Q^*(p_0)+p_{-1}Q^*(p_0), Q^*(p_0)) + \beta\{\alpha W(p_{-1},p_0) + (1-\alpha)W(p_{-1},\tau(Q^*(p_0)))\} \tag{7}$$

.and, as per the definition in Section 3.1, $Q^*(p_0)$ is the solution to the following optimisation problem:

$$\begin{aligned} V(p_0) &= \max_{Q_j} U(1-Q_j+p_0Q_j, Q_j) + \beta\mathbf{E}W(p_0,p_1) \\ &= \max_{Q_j} U(1-Q_j+p_0Q_j, Q_j) + \beta\{\alpha W(p_0,p_0) + (1-\alpha)W(p_0,\tau(Q_j))\} \end{aligned} \tag{8}$$

In words, $W(p_{-1}, p_0)$ is the expected utility derived by a parent with bridging identity p_{-1} from the optimal social group choice of an offspring with bridging identity p_0. Before proceeding with the analysis, we prove the existence of functions $W(p_{-1}, p_0)$ and $Q^*(p_0)$ that satisfy (7) and (8) as well as the uniqueness of $W(p_{-1}, p_0)$.

Define a transformation T as follows:

$$(TW)(p_{-1},p_0) = U(1-Q^*(p_0)+p_{-1}Q^*(p_0), Q^*(p_0)) + \beta\{\alpha W(p_{-1},p_0) + (1-\alpha)W(p_{-1},\tau(Q_j))\} \tag{9}$$

$$Q^*(p_0) = \arg\max_{Q_j} U(1-Q_j+p_0Q_j, Q_j) + \beta\{\alpha W(p_0,p_0) + (1-\alpha)W(p_0,\tau(Q_j))\} \tag{10}$$

where $W(.) \in B\left([0,1]^2\right)$, a space of bounded functions $f : [0,1]\times[0,1] :\to \mathbb{R}$ and $Q^*(p_0) : [0,1] \to [0,0.5]$. We want to show that the transformation T defined by (9) is a contraction with modulus β (see the definition in Stokey, Lucas and Prescott (1989), Chapter 3).

Since $\beta > 0$ and $\alpha \in (0,1)$ and $U\left(1 - Q_j + p_{-1}Q_j, Q_j\right) > 0$, it follows that the transformation T is monotonic.

Consider the transformation $T\left(W + a\right)\left(p_{-1}, p_0\right)$.[6] Using (4), we obtain $T\left(W + a\right)\left(p_{-1}, p_0\right) = \left(TW\right)\left(p_{-1}, p_0\right) + \beta a$. Since $\beta < 1$, it follows that the transformation T satisfies discounting.

Therefore, the required conditions for Theorem 3.3 (Blackwell's Sufficient Conditions for a Contraction) in Stokey, Lucas and Prescott (1989) are satisfied. Therefore, T is a contraction with modulus β. Therefore, Theorem 3.2 (Contraction Mapping Theorem) in Stokey, Lucas and Prescott (1989) applies. Therefore, the transformation T has a unique fixed point. Therefore, (5) has a unique solution in terms of $W\left(p_{-1}, p_0\right)$ and $Q^*\left(p_0\right)$ is well-defined.

Using the first-order condition to the maximisation problem in (8), we obtain

$$\frac{\partial U\left(1 - Q^*\left(p_0\right) + p_0 Q^*\left(p_0\right), Q^*\left(p_0\right)\right)}{\partial P_j}\left(-1 + p_0\right) + \frac{\partial U\left(1 - Q^*\left(p_0\right) + p_0 Q^*\left(p_0\right), Q^*\left(p_0\right)\right)}{\partial Q_j}$$

$$+\beta\left(1 - \alpha\right)\tau'\left(Q^*\left(p_0\right)\right)\frac{\partial W\left(p_0, \tau\left(Q^*\left(p_0\right)\right)\right)}{\partial p_1} \equiv 0 \tag{11}$$

$$\text{or } U_1\left(-1 + p_0\right) + U_2 + \beta\left(1 - \alpha\right)\tau'\left(Q^*\left(p_0\right)\right)W_2 \equiv 0 \tag{12}$$

Then, differentiating throughout the identity in (11) w.r.t. p_0 and applying the Implicit Function Theorem, we obtain

$$\frac{dU_1}{dp_0}\left(-1 + p_0\right) + U_1 + \frac{dU_2}{dp_0} + \beta\left(1 - \alpha\right)\left\{\frac{\partial Q^*}{\partial p_0}\tau''\left(Q^*\left(p_0\right)\right)W_2 + \tau'\left(Q^*\left(p_0\right)\right)\frac{dW_2}{dp_0}\right\} = 0 \tag{13}$$

Note that

$$\begin{aligned}\frac{dU_1}{dp_0} &= U_{11}\left\{-\frac{\partial Q^*}{\partial p_0} + Q^*\left(p_0\right) + p_0\frac{\partial Q^*}{\partial p_0}\right\} + U_{12}\frac{\partial Q^*}{\partial p_0} \\ &= \frac{\partial Q^*}{\partial p_0}\left\{U_{11}\left(-1 + p_0\right) + U_{12}\right\} + U_{11}Q^*\left(p_0\right)\end{aligned} \tag{14}$$

$$\begin{aligned}\frac{dU_2}{dp_0} &= U_{21}\left\{-\frac{\partial Q^*}{\partial p_0} + Q^*\left(p_0\right) + p_0\frac{\partial Q^*}{\partial p_0}\right\} + U_{22}\frac{\partial Q^*}{\partial p_0} \\ &= \frac{\partial Q^*}{\partial p_0}\left\{U_{21}\left(-1 + p_0\right) + U_{22}\right\} + U_{21}Q^*\left(p_0\right)\end{aligned} \tag{15}$$

[6] $\left(f + a\right)\left(x\right)$ is a function defined by $\left(f + a\right)\left(x\right) = f\left(x\right) + a$.

$$\frac{dW_2}{dp_0} = W_{21} + W_{22}\tau'\left(Q^*\left(p_0\right)\right)\frac{\partial Q^*}{\partial p_0} \tag{16}$$

Substituting for $\frac{dU_1}{dp_0}$, $\frac{dU_2}{dp_0}$ and $\frac{dW_2}{dp_0}$ in (13) using (14)-(16), we obtain

$$\begin{aligned}
&\left[\frac{\partial Q^*}{\partial p_0}\left\{U_{11}\left(-1+p_0\right)+U_{12}\right\}+U_{11}Q^*\left(p_0\right)\right]\left(-1+p_0\right)+U_1 \\
&+\left[\frac{\partial Q^*}{\partial p_0}\left\{U_{21}\left(-1+p_0\right)+U_{22}\right\}+U_{21}Q^*\left(p_0\right)\right] \\
&+\beta\left(1-\alpha\right)\left[\frac{\partial Q^*}{\partial p_0}\tau''\left(Q^*\left(p_0\right)\right)W_2+\tau'\left(Q^*\left(p_0\right)\right)\left\{W_{21}+W_{22}\tau'\left(Q^*\left(p_0\right)\right)\frac{\partial Q^*}{\partial p_0}\right\}\right] \\
= \;& 0
\end{aligned}$$

Rearranging the equation, we obtain

$$\begin{aligned}
&\frac{\partial Q^*}{\partial p_0}\left\{U_{11}\left(-1+p_0\right)+U_{12}\right\}\left(-1+p_0\right)+\frac{\partial Q^*}{\partial p_0}\left\{U_{21}\left(-1+p_0\right)+U_{22}\right\} \\
&+\beta\left(1-\alpha\right)\left[\frac{\partial Q^*}{\partial p_0}\tau''\left(Q^*\left(p_0\right)\right)W_2+\frac{\partial Q^*}{\partial p_0}W_{22}\left\{\tau'\left(Q^*\left(p_0\right)\right)\right\}^2\right] \\
= \;& -U_{11}Q^*\left(p_0\right)\left(-1+p_0\right)-U_1-U_{21}Q^*\left(p_0\right)-\beta\left(1-\alpha\right)\tau'\left(Q^*\left(p_0\right)\right)W_{21}
\end{aligned}$$

$$\begin{aligned}
\Longrightarrow\;& \frac{\partial Q^*}{\partial p_0}\left[U_{22}+2U_{21}\left(-1+p_0\right)+U_{11}\left(-1+p_0\right)^2+\beta\left(1-\alpha\right)\left\{\tau''\left(Q^*\left(p_0\right)\right)W_2+W_{22}\left\{\tau'\left(Q^*\left(p_0\right)\right)\right\}^2\right\}\right] \\
=\;& -U_{11}Q^*\left(p_0\right)\left(-1+p_0\right)-U_1-U_{21}Q^*\left(p_0\right)-\beta\left(1-\alpha\right)\tau'\left(Q^*\left(p_0\right)\right)W_{21}
\end{aligned}$$

$$\Longrightarrow \frac{\partial Q^*}{\partial p_0} = -\frac{U_{11}Q^*\left(p_0\right)\left(-1+p_0\right)+U_1+U_{21}Q^*\left(p_0\right)+\beta\left(1-\alpha\right)\tau'\left(Q^*\left(p_0\right)\right)W_{21}}{U_{11}\left(-1+p_0\right)^2+2U_{21}\left(-1+p_0\right)+U_{22}+\beta\left(1-\alpha\right)\left[\tau''\left(Q^*\left(p_0\right)\right)W_2+W_{22}\left\{\tau'\left(Q^*\left(p_0\right)\right)\right\}^2\right]} \tag{17}$$

By assumption, $U_{11}<0, U_{12}>0$ and $U_{22}<0$ and $U_1>0$. Additionally, $\left(-1+p_0\right)<0$. Suppose that $W_{21}>0$ and $W_2 \lesseqgtr 0$ for $p_0 \lesseqgtr p_1$. Suppose also that $W_{22}<0$ for $p_0 \leq p_1$. Then $W_2\left(p_0, \tau\left(Q^*\left(p_0\right)\right)\right) \lesseqgtr 0$ for $p_0 \lesseqgtr \tau\left(Q^*\left(p_0\right)\right)$ and $W_{22}\left(p_0, \tau\left(Q^*\left(p_0\right)\right)\right)$ for $p_0 \leq \tau\left(Q^*\left(p_0\right)\right)$.

Under Assumption 1, we obtain $U_{22}+\beta\left(1-\alpha\right)\tau''\left(Q^*\left(p_0\right)\right)W_2<0$ under all conditions.[7]

[7] To see this, we proceed as follows. Using Corollary 1 to the Contraction Mapping Theorem in Stokey, Lucas and Prescott (1989) and (22), we can show that $\|W_2\| \leq \frac{B_1}{1-\beta\alpha}$. Under Assumption 1, $|\tau''(.)| \leq \frac{B_{22}(1-\beta\alpha)}{B_1\beta(1-\alpha)}$. Therefore,

$$\begin{aligned}
&U_{22}+\beta\left(1-\alpha\right)\tau''\left(Q^*\left(p_0\right)\right)W_2 \\
<\;& -B_{22}+\beta\left(1-\alpha\right)\frac{B_{22}\left(1-\beta\alpha\right)}{B_1\beta\left(1-\alpha\right)}\frac{B_1}{1-\beta\alpha} \\
<\;& 0
\end{aligned}$$

Furthermore, we have $W_{22} < 0$ for $p_0 \leq p_1$ by assumption. Then, the denominator is negative and the numerator is positive. Therefore, $\frac{\partial Q^*}{\partial p_0} > 0$ for $p_0 \leq p_1$.

The only case that remains is where $p_0 > p_1$. For this case, we provide a proof by contradiction. Suppose that, in this case, we have $\frac{\partial Q^*}{\partial p_0} < 0$ for some $p_0 > p_1$ Then, using (17), we must have $W_{22} > 0$. But, if so, we can show, using Corollary 1 to the Contraction Mapping Theorem in Stokey, Lucas and Prescott (1989) that $W_{22} < 0$, which contradicts the preceding assumption. Therefore, we must have $\frac{\partial Q^*}{\partial p_0} > 0$ for $p_0 > p_1$. Thus, we have established the following result.

Lemma 4 *Given functions $U(.), W(.)$ with $W_2 \lesseqgtr 0$ for $p_0 \lesseqgtr p_1$, $W_{22} < 0$ for $p_0 \leq p_1$ and $W_{21} > 0$ for all p_0, p_1; $U_{11}, U_{22} < 0$ and $U_{21} > 0$, Assumption 1, and $Q^*(p_0)$ defined by (10), we obtain $\frac{\partial Q^*}{\partial p_0} > 0$.*

Using (9), we can show that

$$TW_1(p_{-1}, p_0) = U_1 + \beta \{\alpha W_1(p_{-1}, p_0) + (1-\alpha) W_1(p_{-1}, \tau(Q^*(p_0)))\} \tag{18}$$

$$TW_2(p_{-1}, p_0) = \{U_1(-1+p_{-1}) + U_2\} \frac{\partial Q^*}{\partial p_0} + \beta \left\{\alpha W_2(p_{-1}, p_0) + (1-\alpha) W_2(p_{-1}, \tau(Q^*(p_0)))\, \tau'(.) \frac{\partial Q^*}{\partial p_0}\right\} \tag{19}$$

Differentiating throughout (18) w.r.t. p_0, we obtain

$$TW_{12} = \{U_{11}(-1+p_{-1}) + U_{12}\} \frac{\partial Q^*}{\partial p_0} + \beta \left\{\alpha W_{12} + (1-\alpha) W_{12} \tau'(.) \frac{\partial Q^*}{\partial p_0}\right\} \tag{20}$$

From (19), we obtain

$$\begin{aligned} TW_2(p_{-1}, p_0) &= U_1(p_{-1} - p_0) + \{U_1(-1+p_0) + U_2\} \frac{\partial Q^*}{\partial p_0} \\ &\quad + \beta \left\{\alpha W_2(p_{-1}, p_0) + (1-\alpha) W_2(p_{-1}, \tau(Q^*(p_0)))\, \tau'(.) \frac{\partial Q^*}{\partial p_0}\right\} \end{aligned} \tag{21}$$

Then, using the first-order condition in (12) in (21), we obtain

$$TW_2(p_{-1}, p_0) = U_1(p_{-1} - p_0) + \beta \alpha W_2(p_{-1}, p_0) \tag{22}$$

Differentiating throughout (22) w.r.t. p_0, we obtain

$$TW_{22}(p_{-1}, p_0) = \{U_{11}(-1+p_{-1}) + U_{12}\} \frac{\partial Q^*}{\partial p_0} (p_{-1} - p_0) - U_1 + \beta \alpha W_{22}(p_{-1}, p_0) \tag{23}$$

Suppose $W_{12} > 0$, $W_{22} < 0$, $U_{11} < 0$, $U_{12} > 0$. Furthermore, suppose $W_2 \lesseqgtr 0$ for $p_{-1} \lesseqgtr p_0$.

Then, using Lemma 4, we obtain $\frac{\partial Q^*}{\partial p_0} > 0$. Then, from (20), we see that $TW_{12} > 0$. From (22), we see that $TW_2 \lesseqgtr 0$ for $p_{-1} \lesseqgtr p_0$. From (23), we see that $TW_{22} < 0$ for $p_{-1} \leq p_0$.

Then, using Corollary 1 to the Contraction Mapping Theorem in Stokey, Lucas and Prescott (1989), we obtain $W_{12} > 0$ and $W_2, W_{22} < 0$ for $p_{-1} \leq p_0$. Thus, we obtain the following result:

Lemma 5 *Under Assumption 1,* $W_{12} > 0$ *and* $W_2 \lesseqgtr 0$ *for* $p_{-1} \lesseqgtr p_0$, *and* $W_{22} < 0$ *for* $p_{-1} \leq p_0$.

We use the properties of $W(p_{-1}, p_0)$ and $Q^*(p_0)$ established in Lemmas 4 and 5 in the next section.

Appendix B: Theoretical Results on Group Stability and Group Dynamics

Proof. of Lemma 1: Without loss of generality, suppose that $Q_j^A > Q_{j'}^A > 0.5$. Thus, $Q_{j'} > Q_j$. Consider an individual i with $q_i = A$ and $p_i \in (0,1)$. Suppose i strictly prefers social group j to social group j', i.e.

$$U(P_{ji}, Q_j) + \beta \mathbf{E}_j W(p_i, p_o) > U(P_{j'i}, Q_{j'}) + \beta \mathbf{E}_{j'} W(p_i, p_o)$$

where $P_{ji} = 1 - Q_j + Q_j p_i$ and $\mathbf{E}_j$ denotes the expectations operator in the case of an individual in social group j.

$$\Longrightarrow U(P_{j'i}, Q_{j'}) - U(P_{ji}, Q_j) + \beta \mathbf{E}_{j'} W(p_i, p_o) - \beta \mathbf{E}_j W(p_i, p_o) < 0 \tag{24}$$

Note that

$$\frac{\partial}{\partial p_i} \{U(P_{j'i}, Q_{j'}) - U(P_{ji}, Q_j)\} = U_1(P_{j'i}, Q_{j'}) Q_{j'} - U_1(P_{ji}, Q_j) Q_j$$

Under the assumptions $U_{11} < 0$ and $U_{12} \geq 0$, we have $U_1(P_{j'i}, Q_{j'}) > U_1(P_{ji}, Q_j)$ (since $P_{j'i} < P_{ji}$ and $Q_{j'} > Q_j$). Therefore,

$$\frac{\partial}{\partial p_i} \{U(P_{j'i}, Q_{j'}) - U(P_{ji}, Q_j)\} > 0$$

The remaining two terms on the left-hand side of (24) can be rewritten as follows:

$$\beta \mathbf{E}_{j'} W\left(p_i, p_o\right) - \beta \mathbf{E}_j W\left(p_i, p_o\right) = \beta\left(1-\alpha\right)\left\{W\left(p_i, p_{oj'}\right) - W\left(p_i, p_{oj}\right)\right\}$$

where $p_{oj'} = \tau\left(Q_{j'}\right)$ and $p_{oj} = \tau\left(Q_j\right)$. Then, $p_{oj'} > p_{oj}$. ■

Therefore,

$$\frac{\partial}{\partial p_i}\left\{\beta \mathbf{E}_{j'} W\left(p_i, p_o\right) - \beta \mathbf{E}_j W\left(p_i, p_o\right)\right\} = \beta\left(1-\alpha\right)\frac{\partial}{\partial p_i}\left\{W\left(p_i, p_{oj'}\right) - W\left(p_i, p_{oj}\right)\right\}$$

By Lemma 5, $W_{12} > 0$. Then, since $p_{oj'} > p_{oj}$, we have $\frac{\partial}{\partial p_i}\left\{W\left(p_i, p_{oj'}\right) - W\left(p_i, p_{oj}\right)\right\} > 0$. Therefore,

$$\frac{\partial}{\partial p_i}\left\{\beta \mathbf{E}_{j'} W\left(p_i, p_o\right) - \beta \mathbf{E}_j W\left(p_i, p_o\right)\right\} > 0 \tag{25}$$

Therefore, the expression on the LHS of 24 is increasing in p_i.Therefore, for an individual i' with $q_{i'} = A$ and $p_{i'} < p_i$, we obtain

$$U\left(P_{j'i}, Q_{j'}\right) - U\left(P_{ji}, Q_j\right) + \beta \mathbf{E}_{j'} W\left(p_i, p_o\right) - \beta \mathbf{E}_j W\left(p_i, p_o\right) < 0$$

In words, an individual i' also prefers social group j to social group j'. Based on same reasoning, we can show that if i strictly prefers social group j' to social group j, then an individual i' with $q_{i'} = A$ and $p_{i'} > p_i$ also prefers social group j' to social group j.

Proof. of Lemma 2: Without loss of generality, suppose that $Q_{\hat{j}}^A > 0.5 > Q_{\hat{j}}^A$ and $Q_{\hat{j}} > Q_j$, i.e. culture A is in the majority in social group j and in the minority in social group $\hat{j}$ and social group $\hat{j}$ has higher social diversity than social group j Suppose that i strictly prefers social group $\hat{j}$ to social group j, i.e.

$$U\left(P_{\hat{j}i}, Q_{\hat{j}}\right) + \beta \mathbf{E}_{\hat{j}} W\left(p_i, p_o\right) > U\left(P_{ji}, Q_j\right) + \beta \mathbf{E}_j W\left(p_i, p_o\right)$$

$$\Longrightarrow U\left(P_{\hat{j}i}, Q_{\hat{j}}\right) - U\left(P_{ji}, Q_j\right) + \beta \mathbf{E}_{\hat{j}} W\left(p_i, p_o\right) - \beta \mathbf{E}_j W\left(p_i, p_o\right) > 0$$

where $P_{\hat{j}i} = Q_{\hat{j}} + \left(1 - Q_{\hat{j}}\right) p_i$, and $Q_{\hat{k}} = \hat{Q}\left(\tau\left(Q_{\hat{j}}\right)\right)$.

First, consider the case where $P_{\hat{j}i} > P_{ji}$. Then $U\left(P_{\hat{j}i}, Q_{\hat{j}}\right) - U\left(P_{ji}, Q_j\right) > 0$. Additionally, for any individual i' from the same culture and bridging identity $p_{i'} > p_i$, we also obtain

$P_{\hat{\jmath}i'} > P_{ji'}$. Therefore, $U\left(P_{\hat{\jmath}i'}, Q_{\hat{\jmath}}\right) - U\left(P_{ji'}, Q_j\right) > 0$. Using the reasoning in the proof of Lemma 1, we also obtain that

$$\frac{\partial}{\partial p_i}\left\{U\left(P_{\hat{\jmath}i}, Q_{\hat{\jmath}}\right) - U\left(P_{ji}, Q_j\right) + \beta \mathbf{E}_{\hat{\jmath}} W\left(p_i, p_o\right) - \beta \mathbf{E}_j W\left(p_i, p_o\right)\right\} > 0 \tag{26}$$

Therefore, if an individual $\hat{\imath}$ prefers social group $\hat{\jmath}$ to j and $P_{\hat{\jmath}i} > P_{ji}$ then any individual i' from the same culture and higher bridging identity also prefers social group $\hat{\jmath}$ to social group j.

Second, consider the case where $P_{\hat{\jmath}i} < P_{ji}$. We have

$$\frac{\partial}{\partial p_i}\left\{U\left(P_{\hat{\jmath}i}, Q_{\hat{\jmath}}\right) - U\left(P_{ji}, Q_j\right)\right\} = U_1\left(P_{\hat{\jmath}i}, Q_{\hat{\jmath}}\right)\left(1 - Q_{\hat{\jmath}}\right) - U_1\left(P_{ji}, Q_j\right) Q_j \tag{27}$$

By construction, $\left(1 - Q_{\hat{\jmath}}\right) \geq 0.5 > Q_j$. Then, using $U_{11} < 0$ and $U_{12} \geq 0$, we have

$$\frac{\partial}{\partial p_i}\left\{U\left(P_{\hat{\jmath}i}, Q_{\hat{\jmath}}\right) - U\left(P_{ji}, Q_j\right)\right\} > 0 \tag{28}$$

Then we obtain the inequality in (26) based on the same reasoning as above. Therefore, if an individual i' from the same culture as i and higher bridging identity satisfying the condition $P_{\hat{\jmath}i'} < P_{ji'}$ also prefers social group $\hat{\jmath}$ to j. Combining the two results, obtain the first result stated in the lemma.

Next, suppose that an individual i' prefers social group j to $\hat{\jmath}$. Then it must be that an individual i from the same culture as i' and lower bridging identity also (weakly) prefers social group j to $\hat{\jmath}$. If not – i.e. if i strictly prefers social group $\hat{\jmath}$ to j – then this would contradict Lemma 2(i) proven above. ■

Proof. of Lemma 3: Let $Q_{j'} > Q_j$. Without loss of generality, suppose that $Q_j^A > 0.5$, i.e. culture A dominates in social group j. Consider an individual $\hat{\imath}$ with $q_{\hat{\imath}} = B$ and $p_{\hat{\imath}} \in (0, 1)$. Thus, $\hat{\imath}$ belongs to the minority culture in social group j. Suppose that $\hat{\imath}$ strictly prefers social group j to j', i.e.

$$U\left(P_{j\hat{\imath}}, Q_j\right) + \beta \mathbf{E}_j W\left(p_{\hat{\imath}}, p_o\right) > U\left(P_{j'i}, Q_{j'}\right) + \beta \mathbf{E}_{j'} W\left(p_{\hat{\imath}}, p_o\right)$$

$$\Longrightarrow U\left(P_{j\hat{\imath}}, Q_j\right) - U\left(P_{j'i}, Q_{j'}\right) + \beta \mathbf{E}_j W\left(p_{\hat{\imath}}, p_o\right) - \beta \mathbf{E}_{j'} W\left(p_{\hat{\imath}}, p_o\right) > 0$$

where $P_{j\hat{\imath}} = Q_j + (1 - Q_j)\, p_{\hat{\imath}}$ and $\mathbf{E}_j$ is the expectations operator. Note that, for $p_{\hat{\imath}} \in (0,1)$, we have $P_{j'\hat{\imath}} > P_{j\hat{\imath}}$ (whether culture A or B is in the majority in social group j'). Additionally, $Q_{j'} > Q_j$. Therefore $U\left(P_{j\hat{\imath}}, Q_j\right) - U\left(P_{j'\hat{\imath}}, Q_{j'}\right) < 0$. Therefore, we must have

$$\beta \mathbf{E}_j W\left(p_{\hat{\imath}}, p_o\right) - \beta \mathbf{E}_{j'} W\left(p_{\hat{\imath}}, p_o\right) > 0 \tag{29}$$

Furthermore, if $\beta \mathbf{E}_j W\left(p_{\hat{\imath}}, p_o\right) - \beta \mathbf{E}_{j'} W\left(p_{\hat{\imath}}, p_o\right) < 0$, then we obtain

$$U\left(P_{j\hat{\imath}}, Q_j\right) - U\left(P_{j'\hat{\imath}}, Q_{j'}\right) + \beta \mathbf{E}_j W\left(p_{\hat{\imath}}, p_o\right) - \beta \mathbf{E}_{j'} W\left(p_{\hat{\imath}}, p_o\right) < 0$$

which implies that $\hat{\imath}$ strictly prefers social group j' to j. For any individual i with $q_i = q_{\hat{\imath}}$, and $p_i \in (p_{\hat{\imath}}, 1)$, we have $P_{j'i} > P_{ji}$, which implies $U\left(P_{j\hat{\imath}}, Q_j\right) - U\left(P_{j'\hat{\imath}}, Q_{j'}\right) < 0$. Using (25), we obtain $\beta \mathbf{E}_j W\left(p_i, p_o\right) - \beta \mathbf{E}_{j'} W\left(p_i, p_o\right) < 0$. Therefore, we obtain

$$U\left(P_{ji}, Q_j\right) - U\left(P_{j'i}, Q_{j'}\right) + \beta \mathbf{E}_j W\left(p_i, p_o\right) - \beta \mathbf{E}_{j'} W\left(p_i, p_o\right) < 0$$

which means that individual i also prefers social group j' to j. ■

Proposition 7 *The optimal social group for individual i has a level of cultural diversity in the interval* $\left(\min\left\{\hat{Q}\left(p_i\right), \tau^{-1}\left(p_i\right)\right\}, \max\left\{\hat{Q}\left(p_i\right), \tau^{-1}\left(p_i\right)\right\}\right)$.

Proof. of Proposition 7: Suppose $Q_j = \hat{Q}\left(p_i\right) < \tau^{-1}\left(p_i\right) = Q_k$. If $Q_l < Q_j$ then, by construction, $U\left(P_{li}, Q_l\right) < U\left(P_{ji}, Q_j\right)$ and $\mathbf{E}_l W\left(p_i, p_o\right) < \mathbf{E}_j W\left(p_i, p_o\right)$. Therefore,

$$U\left(P_{li}, Q_k\right) + \beta \mathbf{E}_l W\left(p_i, p_o\right) < U\left(P_{ji}, Q_j\right) + \beta \mathbf{E}_j W\left(p_i, p_o\right)$$

Thus, the objective function cannot attain its maximum at any $Q < \hat{Q}\left(p_i\right)$. If $Q_l > Q_j$ then, by construction, $U\left(P_{li}, Q_l\right) < U\left(P_{ki}, Q_k\right)$ and $\beta \mathbf{E}_l W\left(p_i, p_o\right) > \beta \mathbf{E}_k W\left(p_i, p_o\right)$. Therefore,

$$U\left(P_{li}, Q_l\right) + \beta \mathbf{E}_l W\left(p_i, p_o\right) < U\left(P_{ki}, Q_k\right) + \beta \mathbf{E}_k W\left(p_i, p_o\right)$$

Thus, the objective function cannot attain its maximum at any $Q > \tau^{-1}\left(p_i\right)$. Therefore, the optimal value of Q must lie in the interval $\left[\hat{Q}\left(p_i\right), \tau^{-1}\left(p_i\right)\right]$. Similarly, if $\tau^{-1}\left(p_i\right) < Q$, then the optimal value of Q must lie in the interval $\left[\tau^{-1}\left(p_i\right), \hat{Q}\left(p_i\right)\right]$. ■

Proof. of Proposition 1: Consider the subset of social groups $\mathcal{J}_k \subset \mathcal{J}$ dominated by culture k. Let $\mathcal{J}_k^+(j) = \{j' \in \mathcal{J}_k : Q_{j'} > Q_j\}$ and $\mathcal{J}_k^-(j) = \{j' \in \mathcal{J}_k : Q_{j'} < Q_j\}$. Using Lemma 1(i), for each $\hat{\jmath} \in \mathcal{J}_k^+(j)$, there exists a threshold level of bridging identity $\overline{p}_{j\hat{\jmath}}$ such that an individual i from culture k weakly prefers social group j to $\hat{\jmath}$ if and only if $p_i \leq \overline{p}_{j\hat{\jmath}}$. (If all individuals i from culture k prefer social group j to $\hat{\jmath}$, we set $\overline{p}_{j\hat{\jmath}} = 1$). Let $\overline{p}_j = \min\left\{\overline{p}_{j\hat{\jmath}}\right\}_{\hat{\jmath} \in \mathcal{J}_k^+(j)}$. Using Lemma 1(ii), for each $\hat{\jmath} \in \mathcal{J}_k^-(j)$, there exists a threshold level of bridging identity $\underline{p}_{j\hat{\jmath}}$ such that an individual $i \in \mathcal{I}_k$ strictly prefers social group j to $\hat{\jmath}$ if and only if $p_i \geq \underline{p}_{j\hat{\jmath}}$. (If all individuals i from culture k prefer social group j to $\hat{\jmath}$, we set $\underline{p}_{j\hat{\jmath}} = 0$). Therefore, given a set of social groups $\mathcal{J}$, an individual $i \in \mathcal{I}_k$ with bridging identity $p_i \in \left[\underline{p}_j, \overline{p}_j\right]$ weakly prefers social group j to all other social groups in $\mathcal{J}_k \subset \mathcal{J}$ dominated by culture k. Because the expected utility from a social group, as defined in (5), is continuous in p_i we obtain strict preference if $p_i \in \left(\underline{p}_j, \overline{p}_j\right)$. ■

Proof. of Proposition 2: Suppose that social group j does <u>not</u> have the highest level of cultural diversity in $\mathcal{J}$, i.e. there exists a social group $j' \in \mathcal{J}$ with $Q_{j'} > Q_j$. Then, using Lemma 3, we obtain $\mathbf{E}_{j'} W(p_{\hat{\imath}}, p_o) - \mathbf{E}_j W(p_{\hat{\imath}}, p_o) < 0$. ■

Proposition 8 *A social group j is self-replicating if and only if $\alpha = 1$ or $p_i = \tau(Q_j)$ for each group member i.*

Proof. of Proposition 8: First note that, by assumption, all offspring inherit their parents' cultural identity. If $\alpha = 1$ then, by construction, all offspring inherit their parents' bridging identity. And therefore, the social group is self-replicating. If $p_i = \tau(Q_j)$, then offspring either inherit their parents' bridging identity (with probability α) or acquire a bridging identity of $p_o = \tau(Q_j) = p_i$ (with probability $1 - \alpha$). Therefore, the social group is, once again, self-replicating. If $\alpha < 1$ and $\tau(Q_j) \neq p_i$, then with some probability offspring have a bridging identity $p_o = \tau(Q_j) \neq p_i$. Therefore, the social group is not self-replicating. ■

Definition 3 *A set of social groups $\mathcal{J}$ is <u>stationary</u> if, in each period, offspring will choose to remain with the groups in which they were born.*

Proposition 9 *A stationary set of social groups is also stable.*

Proof. of Proposition 9: Suppose that a set of social groups $\mathcal{J}$ is stationary; i.e. for each $j \in \mathcal{J}$ and each i in group j, the offspring o chooses to remain in group j. With probability α offspring o has the same preferences as parent i. Therefore, i also prefers group j to any other social group in $\mathcal{J}$. The same applies to each individual in any social group in $\mathcal{J}$. Therefore, $\mathcal{J}$ constitutes a stable set of social groups. ■

Proposition 10 *Given a set of social groups $\mathcal{J}$, if $\hat{Q}(p_i) = \tau^{-1}(p_i) = Q_j$ for each individual i in social group j, then each social group j is self-replicating and the set $\mathcal{J}$ is stable.*

Proof. of Proposition 10: Suppose offspring o is born of individual i in social group j where i's culture is in the majority. By construction, $p_o = \tau(Q_j) = p_i$. Therefore, social group j is self-replicating. Then, using Proposition 7, $Q^*(p_o)$ lies between $\hat{Q}(p_o)$ and $\tau^{-1}(p_o)$ which is the same as between $\hat{Q}(p_i)$ and Q_j. By assumption, $\hat{Q}(p_i) = Q_j$. Therefore, $Q^*(p_o) = Q_j$. Therefore o will choose to remain in social group j or join an identical social group. Therefore, the set of social groups $\mathcal{J}$ is stationary. Then, by Proposition 9, the set of social groups $\mathcal{J}$ is stable. ■

Proof. of Proposition 3: If a set of social groups is stable, then the preferred set for each individual i in social group j is empty. Then, so is the preferred set for each offspring born in these social groups who experiences direct vertical socialisation; i.e. inherits the parent's bridging identity. Each offspring who experiences oblique socialisation i.e. bridging identity is equal to $\tau(Q_j)$ where j is the social group of birth, has a stronger preference for the social group j than the parent (as there is no disutility arising from imperfect altruism). Therefore, the preferred set for these offspring is also empty. So the set of social groups in the next generation remains stable. The same reasoning applies to subsequent generations. Because of the mechanics of cultural transmission, the probability that an individual in cohort t born in social group j has bridging identity $\tau(Q_j)$ is $1 - \alpha^t$ which converges to 1 as t becomes large (assuming $\alpha < 1$). Thus, there is 'convergence' towards self-replicating social groups.

■

Proof. of Proposition 4: Consider two individuals i and i' who belong to the same culture and opt to join two different social groups j and j' respectively. Suppose individual i prefers

social group j to social group j' and individual i' prefers social group j' to social group j. Without loss of generality, suppose that $q_i = q_{i'} = A$.

Case I: Suppose both social groups are dominated by culture A and $Q_j > Q_{j'}$. By Lemma 1, we must have $p_i > p_{i'}$.

Case II: Suppose social group j is dominated by culture B but j' is dominated by culture A and $Q_j > Q_{j'}$. By Lemma 2, we must have $p_i > p_{i'}$.

Case III: Suppose social group j is dominated by culture B but j' is dominated by culture A and $Q_j < Q_{j'}$. By construction, we have

$$U\left(P_{ji}, Q_j\right) + \beta \mathbf{E}_j W\left(p_i, p_o\right) > U\left(P_{j'i}, Q_{j'}\right) + \beta \mathbf{E}_{j'} W\left(p_i, p_o\right)$$

$$\Longrightarrow U\left(P_{ji}, Q_j\right) - U\left(P_{j'i}, Q_{j'}\right) + \beta \mathbf{E}_j W\left(p_i, p_o\right) - \beta \mathbf{E}_{j'} W\left(p_i, p_o\right) > 0$$

We provide a proof of contradiction. Suppose $p_{i'} \geq p_i$. Then, using (25) we have

$$\mathbf{E}_j W\left(p_{i'}, p_o\right) - \mathbf{E}_{j'} W\left(p_{i'}, p_o\right) > \mathbf{E}_j W\left(p_i, p_o\right) - \mathbf{E}_{j'} W\left(p_i, p_o\right)$$

Additionally, using (28) we have

$$U\left(P_{ji'}, Q_j\right) - U\left(P_{j'i'}, Q_{j'}\right) > U\left(P_{ji}, Q_j\right) - U\left(P_{j'i}, Q_{j'}\right)$$

Therefore, we would have

$$U\left(P_{ji'}, Q_j\right) - U\left(P_{j'i'}, Q_{j'}\right) + \beta \mathbf{E}_j W\left(p_{i'}, p_o\right) - \beta \mathbf{E}_{j'} W\left(p_{i'}, p_o\right) > 0$$

This contradicts the initial assumption that i' opts for social group j' over social group j. Therefore, we must have $p_i > p_{i'}$.

The results obtained for the three cases establish the first part of the proposition.

Case IV: Suppose both social groups are dominated by culture B and $Q_j > Q_{j'}$. Suppose $\mathbf{E}_j W\left(p_i, p_o\right) - \mathbf{E}_{j'} W\left(p_i, p_o\right) > 0$. Then, using Lemma 3, individual i prefers social group j to social group j'. Therefore, the statement of the proposition implies that individual i prefers social group j' to social group j. Additionally, Lemma 3 implies that any individual from the same culture and higher bridging identity also prefers social group j to social group j'. Therefore we must have $p_{i'} < p_i$. ■

Appendix C: Theoretical Results on Immigrants

We denote by $\Gamma_{jt}^{k}(.)$ the c.d.f. of bridging identity among culture k individuals in social group j in period t. We denote by Q_j^0 the level of cultural diversity in social group j in period t. Let $\Gamma_I(.)$ the c.d.f. of bridging identity among the pool of immigrants. .

Proof. of Proposition 5: Consider an influx of immigrants belonging to culture B of size M_{tot} into the population. We denote by $t = 0$ the period in which this influx occurs. All the immigrants will strictly prefer social group j_b to j_a (because they have the same level of cultural diversity and they experience higher social cohesion in social group j_b). Using Lemma 2, we can obtain a threshold level of bridging identity such that the immigrants with bridging identity above the threshold join social group j while those below the threshold join social group j_b. We define $\underline{p}_I(Q_j)$ as the lowest level of bridging identity for which a culture B immigrant would join the social group j with cultural diversity Q_j rather than a culture B homogeneous group. Then the size of the immigrant population that joins social group j is given by $M = M_{tot}\left\{1 - \Gamma_I\left(\underline{p}_I\left(Q_j^0\right)\right)\right\}$. This will lead to an increase in cultural diversity in social group j. Consequently, in the next period, some culture A individuals in social group j may prefer social group j_a to social group j. Specifically, using Lemma 1, we can obtain a threshold level of bridging identity such that the immigrants with bridging identity above the threshold prefer social group j while those below the threshold prefer social group j_a. We define $\underline{p}(M; Q_j)$ as the lowest level of bridging identity for which a culture A individual – in a social group where culture A is in the majority and cultural diversity equals Q_j – would tolerate an influx of immigrants of cultural group B without exiting.

If $M > 0$ and $\Gamma_{j0}^{A}\left(\underline{p}\left(M; Q_j^0\right)\right) = 0$, then an influx of immigrants M increases cultural diversity in social group j but produces no exit from the group. Thus, there is an increase in bridging identity within the population. If $\Gamma_{j0}^{A}\left(\underline{p}\left(M; Q_j^0\right)\right) > 0$ and $\underline{p}\left(M; Q_j^0\right) < \tau\left(Q_j^0\right)$, then the influx leads to exit by a fraction $\alpha\Gamma_{j0}^{A}\left(\underline{p}\left(M; Q_j^0\right)\right)$. Consequently, in the long-run, the influx leads to a bridging identity of zero for the fraction $\alpha\Gamma_{j0}^{A}\left(\underline{p}\left(M; Q_j^0\right)\right)$ of culture A individuals. On the other hand, there is an increase in cultural diversity in social group j and thus, in the long-run, a higher level of bridging identity for the remaining fraction of

culture A individuals (given by $\left\{1-\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)\right\}+(1-\alpha)\,\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)$), as well as all culture B individuals in the social group. Therefore, for M_{tot} and $\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)$ sufficiently small, the influx leads to an increase in the average level of bridging identity in the population. For M_{tot} sufficiently large, cultural diversity in social group j will decline and, thus, there will be a decrease in the level of bridging identity within the population in the long-run. ■

Proof. of Proposition 6: Let us denote by M_{tot} an exogenously given target level of immigration. As in the proof of Proposition 5, we define $M=M_{tot}\left\{1-\Gamma_{I}\left(\underline{p}_{I}\left(Q_{j}^{0}\right)\right)\right\}$.

Consider, first, the case where $\underline{p}\left(M;Q_{j}^{0}\right)\leq\tau\left(Q_{j}^{0}\right)$. As per the reasoning in the proof of Proposition 5, an influx of M_{tot} immigrants at $t=0$ would lead to exit by a fraction $\alpha\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)$ of culture A individuals from social group j at $t=1$. The remainder who have bridging identity below the threshold $\underline{p}\left(M;Q_{j}^{0}\right)$, a fraction equal to $(1-\alpha)\,\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)$, will acquire a bridging identity of $\tau\left(Q_{j}^{0}\right)$ through indirect cultural transmission and, therefore, will not leave the social group. There will be no further exit by culture A individuals in social group j in subsequent periods as all remaining individuals will inherit their parents' bridging identities which, by construction, are above the threshold $\underline{p}\left(M;Q_{j}^{0}\right)$ or will acquire bridging identity through socialisation equal to $\tau\left(Q_{j}^{1}\right)>\tau\left(Q_{j}^{0}\right)$.

If the influx M_{tot} is postponed by T periods, then the proportion of culture A individuals in social group j with bridging identity below the threshold $\underline{p}\left(M;Q_{j}^{0}\right)$ will be given by $\alpha^{T}\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)$ (because socialisation in at least one generation generates a level of bridging identity equal to $\tau\left(Q_{j}^{0}\right)\geq\underline{p}\left(M;Q_{j}^{0}\right)$ in future periods). Therefore, a policy which delays the influx by T periods causes exit by a fraction $\alpha^{T}\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)$. As per the earlier reasoning, there will be no further exit in subsequent periods. Therefore, we obtain the result that increasing the length of time T prior to which the influx occurs decreases the extent of exit from social group j to homogeneous social groups.

Next, consider the case where $\underline{p}\left(M;Q_{j}^{0}\right)>\tau\left(Q_{j}^{0}\right)$. Then, if the influx M_{tot} occurs all in one period, then the proportion of culture A individuals who exit will be given by $\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)+(1-\alpha)\left\{1-\Gamma_{j0}^{A}\left(\underline{p}\left(M;Q_{j}^{0}\right)\right)\right\}$ (this includes all those below the threshold and those above the threshold who experience indirect cultural transmission). In subsequent

periods, there may be more exit depending on the level of $\tau\left(Q_j^1\right)$.

Consider an alternative policy whereby the influx M_{tot} occurs over W periods as described by the sequence $\{M_1', M_2', .., M_W'\}$ such that $M_{tot} = \sum_{w=1}^{W} M_w$. We define $M_w = M_w' \left\{1 - \Gamma_I\left(\underline{p}_I\left(Q_j^{w-1}\right)\right)\right\}$ for $w = 1, .., W$. We proceed with our reasoning in the case where $W = 2$. Then, as per our earlier reasoning, exit in period t is given by $\alpha\Gamma^A_{j(t-1)}\left(\underline{p}\left(M_t; Q_j^{(t-1)}\right)\right)$ for $t = 1, 2$. By construction,

$$\Gamma^A_{j1}\left(\underline{p}\left(M_2; Q_j^1\right)\right) \leq \Gamma^A_{j0}\left(\underline{p}\left(M_1 + M_2; Q_j^0\right)\right) - \alpha\Gamma^A_{j0}\left(\underline{p}\left(M_1; Q_j^0\right)\right)^{8}$$

Therefore, total exit is equal to or less than

$$\alpha\Gamma^A_{j0}\left(\underline{p}\left(M_1; Q_j^0\right)\right) + \alpha\left\{\Gamma^A_{j0}\left(\underline{p}\left(M; Q_j^0\right)\right) - \alpha\Gamma^A_{j0}\left(\underline{p}\left(M_1; Q_j^0\right)\right)\right\}$$

$$\begin{aligned} &< \Gamma^A_{j0}\left(\underline{p}\left(M_1; Q_j^0\right)\right) + \alpha\left\{\Gamma^A_{j0}\left(\underline{p}\left(M; Q_j^0\right)\right) - \Gamma^A_{j0}\left(\underline{p}\left(M_1; Q_j^0\right)\right)\right\} \\ &< \Gamma^A_{j0}\left(\underline{p}\left(M; Q_j^0\right)\right) \end{aligned}$$

which is less than the total exit which occurs if the influx M_{tot} occurs all in one period. Therefore, by spreading the influx over two periods, we reduce the total amount of exit. It is straightforward to show that a similar reasoning holds for larger values of W. ■

[8] If $\tau\left(Q_j^1\right) \leq \underline{p}\left(M_2; Q_j^1\right)$, then

$$\Gamma^A_{j1}\left(\underline{p}\left(M_2; Q_j^1\right)\right) = \Gamma^A_{j0}\left(\underline{p}\left(M_1 + M_2; Q_j^0\right)\right) - \alpha\Gamma^A_{j0}\left(\underline{p}\left(M_1; Q_j^0\right)\right)$$

If $\tau\left(Q_j^1\right) > \underline{p}\left(M_2; Q_j^1\right)$, then

$$\Gamma^A_{j1}\left(\underline{p}\left(M_2; Q_j^1\right)\right) < \Gamma^A_{j0}\left(\underline{p}\left(M_1 + M_2; Q_j^0\right)\right) - \alpha\Gamma^A_{j0}\left(\underline{p}\left(M_1; Q_j^0\right)\right)$$